August 29, 2001

Mr. Brian Ramey
Eli Lilly and Company
1650 Lilly Road
Lafayette, Indiana 47909

Re: Minor Source Modification No:
157-14265-00006

Dear Mr. Ramey:

Eli Lilly and Company applied for a Part 70 operating permit on October 10, 1996 for a pharmaceutical processing plant. An application to modify the source was received on April 10, 2001. Pursuant to 326 IAC 2-7-10.5 the following emission units are approved for construction at the source:

(a) One (1) 1,000 gallon general process, glass lined tank (TK 47-3), located in existing building designated as T27, and capable of being controlled by the existing Regenerative Thermal Oxidizer (RTO) or condenser for VOC emissions.

(b) One (1) 2,000 gallon general process, glass lined tank (TK 35-3), located in existing building designated as T27, and capable of being controlled by the existing Regenerative Thermal Oxidizer (RTO) or condenser for VOC emissions.

The proposed Minor Source Modification approval will be incorporated into the pending Part 70 permit application pursuant to 326 IAC 2-7-10.5(l)(3). The source may begin operation upon issuance of the source modification approval.

This decision is subject to the Indiana Administrative Orders and Procedures Act - IC 4-21.5-3-5. Pursuant to Contract No. A305-0-00-36, IDEM, OAQ has assigned the processing of this application to Eastern Research Group, Inc., (ERG). Therefore, questions should be directed to Mike Pring, ERG, P.O. Box 2010, Morrisville, North Carolina 27560, or call (919) 468-7840 to speak directly to Mr. Pring.

Questions may also be directed to Duane Van Laningham at IDEM, OAQ, 100 North Senate Avenue, P.O. Box 6015, Indianapolis, Indiana, 46206-6015, or call (800) 451-6027, press 0 and ask for Duane Van Laningham, or extension 3-6878, or dial (317) 233-6878.

Sincerely,

Original signed by

Paul Dubenetzky, Chief
Permits Branch
Office of Air Quality

Attachments

ERG/MP
cc: File - Tippecanoe County
U.S. EPA, Region V
Tippecanoe County Health Department
Air Compliance Section Inspector - Eric Courtright
Compliance Data Section - Karen Nowak
Administrative and Development - Janet Mobley
Technical Support and Modeling - Michele Boner

PART 70 MINOR SOURCE MODIFICATION
OFFICE OF AIR QUALITY

Eli Lilly and Company
1650 Lilly Road
Lafayette, Indiana 47909

(herein known as the Permittee) is hereby authorized to construct and operate subject to the conditions contained herein, the emission units described in Section A (Source Summary) of this approval.

This approval is issued in accordance with 326 IAC 2 and 40 CFR Part 70 Appendix A and contains the conditions and provisions specified in 326 IAC 2-7 as required by 42 U.S.C. 7401, et. seq. (Clean Air Act as amended by the 1990 Clean Air Act Amendments), 40 CFR Part 70.6, IC 13-15 and IC 13-17.

Source Modification No.: 157-14265-00006	
Issued by: Original signed by Paul Dubenetzky, Branch Chief Office of Air Quality	Issuance Date: August 29, 2001

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SECTION A SOURCE SUMMARY

This approval is based on information requested by the Indiana Department of Environmental Management (IDEM), Office of Air Quality (OAQ). The information describing the emission units contained in conditions A.1 through A.2 is descriptive information and does not constitute enforceable conditions. However, the Permittee should be aware that a physical change or a change in the method of operation that may render this descriptive information obsolete or inaccurate may trigger requirements for the Permittee to obtain additional permits or seek modification of this approval pursuant to 326 IAC 2, or change other applicable requirements presented in the permit application.

A.1 General Information [326 IAC 2-7-4(c)] [326 IAC 2-7-5(15)]

The Permittee owns and operates a stationary source that produces pharmaceutical products.

Responsible Official:	Kenny McCleary
Source Address:	1650 Lilly Road, Lafayette, Indiana 47909
Mailing Address:	1650 Lilly Road, Lafayette, Indiana 47909
Phone Number:	765-477-4006
SIC Code:	2834 and 2879
County Location:	Tippecanoe
Source Location Status:	Attainment for all criteria pollutants
Source Status:	Part 70 Permit Program Major Source, under PSD or Emission Offset Rules; Major Source, Section 112 of the Clean Air Act

A.2 Emission Units and Pollution Control Equipment Summary [326 IAC 2-7-4(c)(3)] [326 IAC 2-7-5(15)]

This stationary source is approved to construct and operate the following emission units and pollution control devices:

(a) One (1) 1,000 gallon general process, glass lined tank (TK 47-3), located in existing building designated as T27, and capable of being controlled by the existing Regenerative Thermal Oxidizer (RTO) or condenser for VOC emissions.

(b) One (1) 2,000 gallon general process, glass lined tank (TK 35-3), located in existing building designated as T27, and capable of being controlled by the existing Regenerative Thermal Oxidizer (RTO) or condenser for VOC emissions.

The point source emissions from the process vessels may vent directly to RTO1 or TRO2, or they may first vent to scrubbers, process control condensers, vacuum sources, or through other process vessels before going to the RTO. If venting the process vessels to the RTO would cause a safety concern, the process vessels may vent to an alternative pollution control device that complies with 326 IAC 8-5-3.

A.3 Part 70 Permit Applicability [326 IAC 2-7-2]

This stationary source submitted a Part 70 permit application TV 157-6879-00006 on October 6, 1996, pursuant to 326 IAC 2-7-2 (Applicability) because:

(a) It is a major source, as defined in 326 IAC 2-7-1(22);

(b) It is a source in a source category designated by the United States Environmental Protection Agency (U.S. EPA) under 40 CFR 70.3 (Part 70 - Applicability).

SECTION B GENERAL CONSTRUCTION CONDITIONS

B.1 Definitions [326 IAC 2-7-1]

Terms in this permit shall have the definition assigned to such terms in the referenced regulation. In the absence of definitions in the referenced regulation, the applicable definitions found in the statutes or regulations (IC 13-11, 326 IAC 1-2 and 326 IAC 2-7) shall prevail.

B.2 Effective Date of the Permit [IC13-15-5-3]

Pursuant to IC 13-15-5-3, this approval becomes effective upon its issuance.

B.3 Revocation of Permits [326 IAC 2-1.1-9(5)][326 IAC 2-7-10.5(i)]

Pursuant to 326 IAC 2-1.1-9(5)(Revocation of Permits), the Commissioner may revoke this approval if construction is not commenced within eighteen (18) months after receipt of this approval or if construction is suspended for a continuous period of one (1) year or more.

SECTION C GENERAL OPERATION CONDITIONS

C.1 Certification [326 IAC 2-7-4(f)][326 IAC 2-7-6(1)][326 IAC 2-7-5(3)(C)]

(a) Where specifically designated by this permit or required by an applicable requirement, any application form, report, or compliance certification submitted shall contain certification by a responsible official of truth, accuracy, and completeness. This certification shall state that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete.

(b) One (1) certification shall be included, using the attached Certification Form, with each submittal where certification is required by the terms of the applicable rule or specifically designated by this approval.

(c) A responsible official is defined at 326 IAC 2-7-1(34).

C.2 Preventive Maintenance Plan [326 IAC 2-7-5(1),(3) and (13)] [326 IAC 2-7-6(1) and (6)] [326 IAC 1-6-3]

(a) If required by specific condition(s) in Section D of this permit, the Permittee shall prepare and maintain Preventive Maintenance Plans (PMPs) when operation begins, including the following information on each facility:

(1) Identification of the individual(s) responsible for inspecting, maintaining, and repairing emission control devices;

(2) A description of the items or conditions that will be inspected and the inspection schedule for said items or conditions; and

(3) Identification and quantification of the replacement parts that will be maintained in inventory for quick replacement.

If, due to circumstances beyond the Permittee's control, the PMPs cannot be prepared and maintained within the above time frame, the Permittee may extend the date an additional ninety (90) days provided the Permittee notifies:

Indiana Department of Environmental Management
Compliance Branch, Office of Air Quality
100 North Senate Avenue, P. O. Box 6015
Indianapolis, Indiana 46206-6015

The PMP and the PMP extension notification do not require the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

(b) The Permittee shall implement the PMPs as necessary to ensure that failure to implement a PMP does not cause or contribute to a violation of any limitation on emissions or potential to emit.

(c) A copy of the PMPs shall be submitted to IDEM, OAQ, upon request and within a reasonable time, and shall be subject to review and approval by IDEM, OAQ. IDEM, OAQ, may require the Permittee to revise its PMPs whenever lack of proper maintenance causes or contributes to any violation. The PMP does not require the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

(d) Records of preventive maintenance shall be retained for a period of at least five (5) years. These records shall be kept at the source location for a minimum of three (3) years. The records may be stored elsewhere for the remaining two (2) years as long as they are available upon request. If the Commissioner makes a request for records to

the Permittee, the Permittee shall furnish the records to the Commissioner within a reasonable time.

C.3 Permit Amendment or Modification [326 IAC 2-7-11] [326 IAC 2-7-12]

(a) Permit amendments and modifications are governed by the requirements of 326 IAC 2-7-11 or 326 IAC 2-7-12 whenever the Permittee seeks to amend or modify this permit.

(b) Any application requesting an amendment or modification of this permit shall be submitted to:

Indiana Department of Environmental Management
Permits Branch, Office of Air Quality
100 North Senate Avenue, P.O. Box 6015
Indianapolis, Indiana 46206-6015

Any such application shall be certified by the "responsible official" as defined by 326 IAC 2-7-1(34).

(c) The Permittee may implement administrative amendment changes addressed in the request for an administrative amendment immediately upon submittal of the request. [326 IAC 2-7-11(c)(3)]

C.4 Opacity [326 IAC 5-1]

Pursuant to 326 IAC 5-1-2 (Opacity Limitations), except as provided in 326 IAC 5-1-3 (Temporary Alternative Opacity Limitations), opacity shall meet the following, unless otherwise stated in this permit:

(a) Opacity shall not exceed an average of forty percent (40%) in any one (1) six (6) minute averaging period as determined in 326 IAC 5-1-4.

(b) Opacity shall not exceed sixty percent (60%) for more than a cumulative total of fifteen (15) minutes (sixty (60) readings as measured according to 40 CFR 60, Appendix A, Method 9 or fifteen (15) one (1) minute nonoverlapping integrated averages for a continuous opacity monitor) in a six (6) hour period.

C.5 Fugitive Dust Emissions [326 IAC 6-4]

The Permittee shall not allow fugitive dust to escape beyond the property line or boundaries of the property, right-of-way, or easement on which the source is located, in a manner that would violate 326 IAC 6-4 (Fugitive Dust Emissions). 326 IAC 6-4-2(4) is not federally enforceable.

C.6 Operation of Equipment [326 IAC 2-7-6(6)]

Except as otherwise provided by statute or rule, or in this permit, all air pollution control equipment listed in this permit and used to comply with an applicable requirement shall be operated at all times that the emission units vented to the control equipment are in operation.

Testing Requirements [326 IAC 2-7-6(1)]

C.7 Performance Testing [326 IAC 3-6][326 IAC 2-1.1-11]

(a) Compliance testing on new emission units shall be conducted within 60 days after achieving maximum production rate, but no later than 180 days after initial start-up, if specified in Section D of this approval. All testing shall be performed according to the provisions of 326 IAC 3-6 (Source Sampling Procedures), except as provided elsewhere in this approval, utilizing any applicable procedures and analysis methods specified in 40 CFR 51, 40 CFR 60, 40 CFR 61, 40 CFR 63, 40 CFR 75, or other procedures approved by IDEM, OAQ.

A test protocol, except as provided elsewhere in this approval, shall be submitted to:

Indiana Department of Environmental Management
Compliance Data Section, Office of Air Quality
100 North Senate Avenue, P. O. Box 6015
Indianapolis, Indiana 46206-6015

no later than thirty-five (35) days prior to the intended test date. The protocol submitted by the Permittee does not require certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

(b) The Permittee shall notify IDEM, OAQ of the actual test date at least fourteen (14) days prior to the actual test date. The notification submitted by the Permittee does not require certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

(c) Pursuant to 326 IAC 3-6-4(b), all test reports must be received by IDEM, OAQ within forty-five (45) days after the completion of the testing. An extension may be granted by IDEM, OAQ, if the source submits to IDEM, OAQ, a reasonable written explanation within five (5) days prior to the end of the initial forty-five (45) day period.

Compliance Requirements [326 IAC 2-1.1-11]

C.8 Compliance Requirements [326 IAC 2-1.1-11]

The commissioner may require stack testing, monitoring, or reporting at any time to assure compliance with all applicable requirements. Any monitoring or testing shall be performed in accordance with 326 IAC 3 or other methods approved by the commissioner or the U. S. EPA.

Compliance Monitoring Requirements [326 IAC 2-7-5(1)] [326 IAC 2-7-6(1)]

C.9 Compliance Monitoring [326 IAC 2-7-5(3)] [326 IAC 2-7-6(1)]

If required by Section D, all monitoring and record keeping requirements shall be implemented when operation begins. The Permittee shall be responsible for installing any necessary equipment and initiating any required monitoring related to that equipment.

Corrective Actions and Response Steps [326 IAC 2-7-5] [326 IAC 2-7-6]

C.10 Compliance Monitoring Plan - Failure to Take Response Steps [326 IAC 2-7-5] [326 IAC 2-7-6]

(a) The Permittee is required to implement a compliance monitoring plan to ensure that reasonable information is available to evaluate its continuous compliance with applicable requirements. The compliance monitoring plan can be either an entirely new document, consist in whole of information contained in other documents, or consist of a combination of new information and information contained in other documents. If the compliance monitoring plan incorporates by reference information contained in other documents, the Permittee shall identify as part of the compliance monitoring plan the documents in which the information is found. The elements of the compliance monitoring plan are:

(1) This condition;

(2) The Compliance Determination Requirements in Section D of this permit;

(3) The Compliance Monitoring Requirements in Section D of this permit;

(4) The Record Keeping and Reporting Requirements in Section C (General Record Keeping Requirements, and General Reporting Requirements) and in Section D of this permit; and

(5) A Compliance Response Plan (CRP) for each compliance monitoring condition of this permit. CRP's shall be submitted to IDEM, OAQ upon request and shall

be subject to review and approval by IDEM, OAQ. The CRP shall be prepared within ninety (90) days after issuance of this permit by the Permittee and maintained on site, and is comprised of:

(A) Reasonable response steps that may be implemented in the event that compliance related information indicates that a response step is needed pursuant to the requirements of Section D of this permit; and

(B) A time schedule for taking reasonable response steps including a schedule for devising additional response steps for situations that may not have been predicted.

(b) For each compliance monitoring condition of this permit, reasonable response steps shall be taken when indicated by the provisions of that compliance monitoring condition. Failure to take reasonable response steps may constitute a violation of the permit.

(c) Upon investigation of a compliance monitoring excursion, the Permittee is excused from taking further response steps for any of the following reasons:

(1) A false reading occurs due to the malfunction of the monitoring equipment. This shall be an excuse from taking further response steps providing that prompt action was taken to correct the monitoring equipment.

(2) The Permittee has determined that the compliance monitoring parameters established in the permit conditions are technically inappropriate, has previously submitted a request for an administrative amendment to the permit, and such request has not been denied.

(3) An automatic measurement was taken when the process was not operating.

(4) The process has already returned or is returning to operating within “normal” parameters and no response steps are required.

(d) Records shall be kept of all instances in which the compliance related information was not met and of all response steps taken. In the event of an emergency, the provisions of 326 IAC 2-7-16 (Emergency Provisions) requiring prompt corrective action to mitigate emissions shall prevail.

(e) All monitoring required in Section D shall be performed at all times the equipment is operating. If monitoring is required by Section D and the equipment is not operating, then the Permittee may record the fact that the equipment is not operating or perform the required monitoring.

(f) At its discretion, IDEM may excuse the Permittee’s failure to perform the monitoring and record keeping as required by Section D, if the Permittee provides adequate justification and documents that such failures do not exceed five percent (5%) of the operating time in any quarter. Temporary, unscheduled unavailability of qualified staff shall be considered a valid reason for failure to perform the monitoring or record keeping requirements in Section D.

C.11 Emergency Provisions [326 IAC 2-7-16]

(a) An emergency, as defined in 326 IAC 2-7-1(12), is not an affirmative defense for an action brought for noncompliance with a federal or state health-based emission limitation, except as provided in 326 IAC 2-7-16.

(b) An emergency, as defined in 326 IAC 2-7-1(12), constitutes an affirmative defense to an action brought for noncompliance with a health-based or technology-based emission

limitation if the affirmative defense of an emergency is demonstrated through properly signed, contemporaneous operating logs or other relevant evidence that describe the following:

(1) An emergency occurred and the Permittee can, to the extent possible, identify the causes of the emergency;

(2) The permitted facility was at the time being properly operated;

(3) During the period of an emergency, the Permittee took all reasonable steps to minimize levels of emissions that exceeded the emission standards or other requirements in this permit;

(4) For each emergency lasting one (1) hour or more, the Permittee notified IDEM, OAQ, within four (4) daytime business hours after the beginning of the emergency, or after the emergency was discovered or reasonably should have been discovered;

Telephone Number: 1-800-451-6027 (ask for Office of Air Quality, Compliance Section), or
Telephone Number: 317-233-5674 (ask for Compliance Section)
Facsimile Number: 317-233-5967

(5) For each emergency lasting one (1) hour or more, the Permittee submitted the attached Emergency Occurrence Report Form or its equivalent, either by mail or facsimile to:

Indiana Department of Environmental Management
Compliance Branch, Office of Air Quality
100 North Senate Avenue, P. O. Box 6015
Indianapolis, Indiana 46206-6015

within two (2) working days of the time when emission limitations were exceeded due to the emergency.

The notice fulfills the requirement of 326 IAC 2-7-5(3)(C)(ii) and must contain the following:

(A) A description of the emergency;

(B) Any steps taken to mitigate the emissions; and

(C) Corrective actions taken.

The notification which shall be submitted by the Permittee does not require the certification by the “responsible official” as defined by 326 IAC 2-7-1(34).

(6) The Permittee immediately took all reasonable steps to correct the emergency.

(c) In any enforcement proceeding, the Permittee seeking to establish the occurrence of an emergency has the burden of proof.

(d) This emergency provision supersedes 326 IAC 1-6 (Malfunctions). This permit condition is in addition to any emergency or upset provision contained in any applicable requirement.

(e) IDEM, OAQ, may require that the Preventive Maintenance Plans required under 326 IAC 2-7-4-(c)(10) be revised in response to an emergency.

(f) Failure to notify IDEM, OAQ, by telephone or facsimile of an emergency lasting more than one (1) hour in accordance with (b)(4) and (5) of this condition shall constitute a violation of 326 IAC 2-7 and any other applicable rules.

(g) Operations may continue during an emergency only if the following conditions are met:

(1) If the emergency situation causes a deviation from a technology-based limit, the Permittee may continue to operate the affected emitting facilities during the emergency provided the Permittee immediately takes all reasonable steps to correct the emergency and minimize emissions.

(2) If an emergency situation causes a deviation from a health-based limit, the Permittee may not continue to operate the affected emissions facilities unless:

(A) The Permittee immediately takes all reasonable steps to correct the emergency situation and to minimize emissions; and

(B) Continued operation of the facilities is necessary to prevent imminent injury to persons, severe damage to equipment, substantial loss of capital investment, or loss of product or raw materials of substantial economic value.

Any operation shall continue no longer than the minimum time required to prevent the situations identified in (g)(2)(B) of this condition.

C.12 Actions Related to Noncompliance Demonstrated by a Stack Test [326 IAC 2-7-5] [326 IAC 2-7-6]

(a) When the results of a stack test performed in conformance with Section C - Performance Testing, of this permit exceed the level specified in any condition of this permit, the Permittee shall take appropriate response actions. The Permittee shall submit a description of these response actions to IDEM, OAQ, within thirty (30) days of receipt of the test results. The Permittee shall take appropriate action to minimize excess emissions from the affected facility while the response actions are being implemented.

(b) A retest to demonstrate compliance shall be performed within one hundred twenty (120) days of receipt of the original test results. Should the Permittee demonstrate to IDEM, OAQ that retesting in one-hundred and twenty (120) days is not practicable, IDEM, OAQ may extend the retesting deadline.

(c) IDEM, OAQ reserves the authority to take any actions allowed under law in response to noncompliant stack tests.

The documents submitted pursuant to this condition do not require the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

Record Keeping and Reporting Requirements [326 IAC 2-7-5(3)] [326 IAC 2-7-19]

C.13 General Record Keeping Requirements [326 IAC 2-7-5(3)][326 IAC 2-7-6]

(a) Records of all required data, reports and support information shall be retained for a period of at least five (5) years from the date of monitoring sample, measurement, report, or application. These records shall be kept at the source location for a minimum of three (3) years. The records may be stored elsewhere for the remaining two (2) years as long as they are available upon request. If the Commissioner makes a request for

records to the Permittee, the Permittee shall furnish the records to the Commissioner within a reasonable time.

(b) Unless otherwise specified in this permit, all record keeping requirements not already legally required shall be implemented within ninety (90) days of permit issuance.

C.14 General Reporting Requirements [326 IAC 2-7-5(3)(C)]

(a) The source shall submit the attached Quarterly Deviation and Compliance Monitoring Report or its equivalent. Any deviation from permit requirements, the date(s) of each deviation, the cause of the deviation, and the response steps taken must be reported. This report shall be submitted within thirty (30) days of the end of the reporting period. The Quarterly Deviation and Compliance Monitoring Report shall include the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

(b) The report required in (a) of this condition and reports required by conditions in Section D of this permit shall be submitted to:

Indiana Department of Environmental Management
Compliance Data Section, Office of Air Quality
100 North Senate Avenue, P. O. Box 6015
Indianapolis, Indiana 46206-6015

(c) Unless otherwise specified in this permit, any notice, report, or other submission required by this permit shall be considered timely if the date postmarked on the envelope or certified mail receipt, or affixed by the shipper on the private shipping receipt, is on or before the date it is due. If the document is submitted by any other means, it shall be considered timely if received by IDEM, OAQ, on or before the date it is due.

(d) Unless otherwise specified in this permit, all reports required in Section D of this permit shall be submitted within thirty (30) days of the end of the reporting period. All reports do require the certification by the "responsible official" as defined by 326 IAC 2-7-1(34).

(e) The first report shall cover the period commencing on the date of issuance of this permit and ending on the last day of the reporting period. Reporting periods are based on calendar years.

SECTION D.1 FACILITY OPERATION CONDITIONS

Facility Description [326 IAC 2-7-5(15)]

(a) One (1) 1,000 gallon general process, glass lined tank (TK 47-3), located in existing building designated as T27, and capable of being controlled by the existing Regenerative Thermal Oxidizer (RTO) or condenser for VOC emissions.

(b) One (1) 2,000 gallon general process, glass lined tank (TK 35-3), located in existing building designated as T27, and capable of being controlled by the existing Regenerative Thermal Oxidizer (RTO) or condenser for VOC emissions.

(The information describing the process contained in this facility description box is descriptive information and does not constitute enforceable conditions.)

Emission Limitations and Standards

D.1.1 Miscellaneous Operation: Synthesized Pharmaceutical Manufacturing [326 IAC 8-5-3]

(a) Pursuant to 326 IAC 8-5-3 when using condensers to control the VOC emissions from these process tanks the outlet gas temperature shall not exceed the following:

(1) minus twenty-five degrees Celsius (-25^{0}C) when condensing VOC of vapor pressure greater than forty (40) kilo Pascals (five and eight-tenths (5.8) pounds per square inch);

(2) minus fifteen degrees Celsius (-15^{0}C) when condensing VOC of vapor pressure greater than twenty (20) kilo Pascals (two and nine-tenths (2.9) pounds per square inch);

(3) zero degrees Celsius (0^{o}C) when condensing VOC of vapor pressure greater than ten (10) kilo Pascals (one and five-tenths (1.5) pounds per square inch);

(4) ten degrees Celsius (10^{o}C) when condensing VOC of vapor pressure greater than seven (7) kilo Pascals (one (1) pounds per square inch); or

(5) twenty -five degrees Celsius (25^{o}C) when condensing VOC of vapor pressure greater than three and five-tenths (3.5) kilo Pascals (five-tenths (0.5) pounds per square inch).

(b) Pursuant to 326 IAC 8-5-3(b)(1)(C), when using equivalent controls, the VOC emissions shall be reduced by at least as much as they would be by using a surface condenser which meets the requirements of conditions (a)(1) through (a)(5) as applicable. The approximate equivalent required minimum control efficiency for the RTO is 90%.

(c) Pursuant to 326 IAC 8-5-3(b)(5) the Permittee shall install covers on all in process tanks that contain VOC's. These covers shall be kept closed unless production sampling, maintenance, or inspection procedures require operator access.

(d) Pursuant to 326 IAC 8-5-3(b)(6) the Permittee shall repair all visible leaks from which a liquid, containing VOC can be observed running or dripping. The repair shall be completed the first time the equipment is off line for a period of time long enough to complete the repair.

Compliance Determination Requirements

D.1.2 Testing Requirements [326 IAC 2-7-6(1),(6)][326 IAC 2-1.1-11]

The Permittee is not required to test the facility by this permit. The testing required for this facility will be deferred and shall follow the schedule in the Title V Permit, to determine compliance with 326 IAC 8-5-3. However, IDEM may require compliance testing when necessary to determine if the facilities are in compliance. If testing is required by IDEM compliance with Condition D.1.1 shall be determined by a performance test conducted in accordance with Section C - Performance Testing.

Compliance Monitoring Requirements [326 IAC 2-7-6(1)] [326 IAC 2-7-5(1)]

D.1.3 Monitoring For VOC Emissions

(a) The VOC emissions from the proposed general replacement process tanks (TK 35-3 and TK 47-3) shall be in compliance with 326 IAC 8-5-3 provided that:

(1) the Regenerative Thermal Oxidizers (RTO1 or RTO2) or Condensers (when Lilly elects to control the VOC by condensers) shall operate at all times the equipment being controlled are in operation and emitting VOC;

(2) when the VOC emissions from the proposed general process tanks are controlled by RTO1 or RTO2, the RTO's operating temperature shall be maintained at 1600^0F, or the temperature determined during the most recent stack tests, to maintain at least 90% destruction of the volatile organic compounds. The operating temperature of the RTO shall be recorded and monitored continuously;

(3) when the VOC emissions from the proposed general process tanks are controlled by the condensers, the outlet gas temperature shall be equal to or less than that specified by 326 IAC 8-5-3, see condition D.1.1;

(4) the Permittee records the time during which the proposed process tanks were emitting VOC but the RTO or condensers, serving the proposed process tank, were not operated;

(5) the Permittee records the reason the RTO or condensers were not operated during the period referred to in (4);

(6) the Permittee records the corrective actions taken to bring the RTO or condensers to normal operation during the period referred to in (4); and

(7) the Permittee records the number of hours the proposed process tanks, were emitting VOC and vented to points other than the RTO or a condenser complying with 326 IAC 8-5-3.

D.1.4 National Emission Standards for Hazardous Air Pollutants (NESHAPs) 40 CFR Part 63, Subparts I and H, 326 IAC 20 (Hazardous Air Pollutants)

That the owner or operator shall implement the Lilly Leak Detection and Repair (LDAR) Program, most recently approved by the Office of Air Quality to reduce fugitive emissions from processes that use methylene chloride. If it is not feasible to either pressure test a group of fugitive sources or monitor a specific compound, then a written justification will be required for each source or compound exempted from testing. Any necessary adjustments to the procedures shall be submitted to the Office of Air Quality for approval prior to implementation.

D.1.5 40 CFR Part 63, Subpart GGG (National Emissions Standard for Pharmaceutical Production), 326 IAC 20 (Hazardous Air Pollutants)

The proposed general replacement process tanks are subject to the National Emission Standards for Hazardous Air Pollutants 40 CFR Part 63, Subpart GGG (National Emissions Standard for Pharmaceutical Production) and shall be in compliance with this NESHAP by the compliance date.

General tank TK47-3 and charge tank TK35-3do not constitute a new or reconstructed affected source under Subpart GGG, nor do they constitute a new or reconstructed pharmaceutical manufacturing process unit. Therefore, the existing source requirements of Subpart GGG will apply.

Record Keeping and Reporting Requirements

D.1.6 Record Keeping Requirements

(a) To document compliance with Conditions D.1.1 and D.1.3, the Permittee shall maintain records as follows:

(1) The malfunction report of the RTOs; and applicable malfunction reports when the facility is emitting VOC, but not venting to the RTO;

(2) Weekly records of the operating temperature of the RTOs during normal operation when TK47-3 orTK 35-3 are emitting VOC.;

(3) The number of hours the proposed process tanks were vented to points other than the RTO or the condenser.

(b) To document compliance with Condition D.1.4, an owner or operator of the facility covered by this permit, when using methylene chloride, shall comply with the record keeping requirements provided in Leak Detection and Repair (LDAR) Program proposed by Eli Lilly and most recently approved by the Office of Air Quality.

(c) All records shall be maintained in accordance with Section C - General Record Keeping Requirements, of this permit.

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR QUALITY
COMPLIANCE DATA SECTION

PART 70 SOURCE MODIFICATION CERTIFICATION

Source Name: Eli Lilly and Company
Source Address: 1650 Lilly Road, Lafayette, Indiana 47909
Mailing Address: 1650 Lilly Road, Lafayette, Indiana 47909
Source Modification No.: 157-14265-00006

This certification shall be included when submitting monitoring, testing reports/results or other documents as required by this approval.

Please check what document is being certified:

9 Test Result (specify) _____

9 Report (specify) _____

9 Notification (specify) _____

9 Affidavit (specify) _____

9 Other (specify) _____

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete.

Signature:

Printed Name:

Title/Position:

Date:

Indiana Department of Environmental Management
Office of Air Quality

Technical Support Document (TSD) for a
Part 70 Minor Source Modification

Source Background and Description

Source Name:	Eli Lilly and Company
Source Location:	1650 Lilly Road, Lafayette, Indiana 47909
County:	Tippecanoe
SIC Code:	2834 and 2879
Operation Permit No.:	157-6879-00006
Operation Permit Issuance Date:	not yet issued
Minor Source Modification No.:	157-14265-00006
Permit Reviewer:	ERG/MP

The Office of Air Quality (OAQ) has reviewed a modification application from Eli Lilly and Company relating to the construction of the following emission units and pollution control devices:

(a) One (1) 1,000 gallon general process, glass lined tank (TK 47-3), located in existing building designated as T27, and capable of being controlled by the existing Regenerative Thermal Oxidizer (RTO) or condenser for VOC emissions.

(b) One (1) 2,000 gallon general process, glass lined tank (TK 35-3), located in existing building designated as T27, and capable of being controlled by the existing Regenerative Thermal Oxidizer (RTO) or condenser for VOC emissions.

History

On April 10, 2001, Eli Lilly and Company, submitted an application to the OAQ requesting to replace two tanks at their existing plant. Eli Lilly and Company submitted a Part 70 permit application (T157-6879-00006) on October 10, 1996.

Enforcement Issue

There are no enforcement actions pending.

Stack Summary

Stack ID	Height (feet)	Diameter (feet)	Flow Rate (acfm)	Temperature (^{0}F)
RT01	125	9	98,000	170
or RT02	125	9	98,000	125

Recommendation

The staff recommends to the Commissioner that the Part 70 Minor Source Modification be approved. This recommendation is based on the following facts and conditions:

Unless otherwise stated, information used in this review was derived from the application and additional information submitted by the applicant.

An application for the purposes of this review was received on April 10, 2001

Emission Calculations

The calculations submitted by the applicant have been verified and found to be accurate and correct. These calculations are provided in Appendix A of this document (20 pages).

Potential To Emit of Modification

Pursuant to 326 IAC 2-1.1-1(16), Potential to Emit is defined as "the maximum capacity of a stationary source to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or type or amount of material combusted, stored, or processed shall be treated as part of its design if the limitation is enforceable by the U.S. EPA."

This table reflects the PTE before controls. Control equipment is not considered federally enforceable until it has been required in a federally enforceable permit or where a Federally approved SIP regulation applies to the modification.

Pollutant	Potential To Emit (tons/year)
PM	0.0
PM-10	0.0
SO_2	90.9
VOC	64.27
CO	59.32
NO_x	5.09

HAP's	Potential To Emit (tons/year)
HCl (gas)	36
TOTAL	36

Justification for Modification

The Part 70 Operating permit is being modified through a Part 70 Minor Source Modification. This modification is being performed pursuant to 326 IAC 2-7-10.5(d)(8) as this project consists solely of the replacement of two process tanks and will have no effect on actual or potential emissions.

County Attainment Status

The source is located in Tippecanoe County.

Pollutant	Status
PM-10	attainment
SO_2	attainment
NO_2	attainment

Pollutant	Status
Ozone	attainment
CO	attainment
Lead	attainment

(a) Volatile organic compounds (VOC) and oxides of nitrogen (NOx) are precursors for the formation of ozone. Therefore, VOC and NO_X emissions are considered when evaluating the rule applicability relating to the ozone standards. Tippecanoe County has been designated as attainment or unclassifiable for ozone. Therefore, VOC and NOx emissions were reviewed pursuant to the requirements for Prevention of Significant Deterioration (PSD), 326 IAC 2-2 and 40 CFR 52.21.

(b) Tippecanoe County has been classified as attainment or unclassifiable for SO_X. Therefore, these emissions were reviewed pursuant to the requirements for Prevention of Significant Deterioration (PSD), 326 IAC 2-2 and 40 CFR 52.21.

Source Status

Existing Source PSD or Emission Offset Definition (emissions after controls, based upon 8760 hours of operation per year at rated capacity and/or as otherwise limited):

Pollutant	Emissions (tons/yr)
PM	682.1
PM-10	682.1
SO_2	5,626
VOC	5,351
CO	363
NO_x	2,834

(a) This existing source is a major stationary source because an attainment regulated pollutant is emitted at a rate of 100 tons per year or more, and it is one of the 28 listed source categories.

(b) These emissions are based upon AIRS Facility Quick Look Report, updated January 22, 1999.

Potential to Emit of Modification After Issuance

The table below summarizes the potential to emit, reflecting all limits, of the significant emission units after controls. The control equipment is considered federally enforceable only after issuance of this Part 70 source modification permit or where a Federally approved SIP regulation applies to the modification.

	Potential to Emit (tons/year)					
Tanks Replacement	Capacity (Gallons	VOC & Organic HAPs	CO	SO_2	NOx	Inorganic HAPs
TK 35-3	2000	3.90*	1.0**	1.0**	3.39	24.00
	Fugitive	3.58				
TK 47-3	1000	2.02*	19.77	30.30	1.70	12.00
	Fugitive	3.13				
Total		12.63*	20.77	31.30	5.09	36.00

* Tanks TK 35-3 & TK 47-3 are subject to 326 IAC 8-5-3. Therefore, PTE is after applying the control standards required in 326 IAC 8-5-3.

** Tank TK 35-3 is a part of Unit 35 in T27. Operating Permit number 79-04-90-0382 (Construction Permit PC (79) 1491) restricts Unit 35's sulfur dioxide emissions to 1 ton per year and CO emissions to 1 tons per year (ref. Construction Permit PC (79) 1527). Therefore, Tank TK-35-3's sulfur dioxide and carbon monoxide emissions will be included in the total emissions for Unit 35.

Federal Rule Applicability

(a) The tanks are not subject to New Source Performance Standard, 326 IAC 12, (40 CFR Part 60.110b, Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels), because they are not used for VOC storage purposes.

(b) The tanks are not subject to New Source Performance Standard, 326 IAC 12, (40 CFR Part 60.480, Subpart VV - Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemical Manufacturing Industry (SOCMI)), because the tanks are not used to make Synthetic Organic Chemical Manufacturing Industry listed products.

(c) The tanks are not subject to New Source Performance Standard, 326 IAC 12, (40 CFR Part 60.610, Subpart III, Standards of Performance for Volatile Organic Compounds (VOC) Emissions from Synthetic Organic Chemical Manufacturing Industry (SOCMI) Air Oxidation Unit Processes), because they are not air oxidation units.

(d) The tanks are not subject to New Source Performance Standard, 326 IAC 12, (40 CFR Part 60.660, Subpart NNN, Standards of Performance for Volatile Organic Compounds (VOC) Emissions from Synthetic Organic Chemical Manufacturing Industry (SOCMI) Distillation Operations), because the tanks are not used to make Synthetic Organic Chemical Manufacturing Industry listed products.

(e) The tanks are not subject to New Source Performance Standard, 326 IAC 12, (40 CFR Part 60.700, Subpart RRR, Standards of Performance for Volatile Organic Compounds (VOC) Emissions from Synthetic Organic Chemical Manufacturing Industry (SOCMI) Reactor Processes), because the tanks are not used to make Synthetic Organic Chemical Manufacturing Industry listed products.

(f) The tanks are subject to National Emission Standards for Hazardous Air Pollutants(NESHAP), 326 IAC 14,(40 CFR 63.190(b)(5), Subpart H and I (40 CFR Part 63, Subpart H - National Emission Standards for Organic Hazardous Air Pollutants for Equipment Leaks and 40 CFR Part 63, Subpart I -National Emission Standards for Organic Hazardous Air Pollutants for Certain Processes. Subject to the Negotiated Regulation for Equipment Leaks) when Methylene Chloride is used in them for pharmaceutical synthesis operations. Eli Lilly will comply with these requirements, with

the implementation of Eli Lilly's LDAR program, when Methylene Chloride is used in the tanks.

(g) The proposed process tanks are regulated under 40 CFR Part 63, Subpart GGG - National Emission Standards for Hazardous Air Pollutants for Pharmaceutical Production, which was promulgated on September 21, 1998. The addition of these tanks is neither the construction or the reconstruction of an affected facility or a PMPU as defined by Subpart GGG. Therefore, these tanks are subject to the standards for existing sources in Subpart GGG. These process tanks shall be in compliance with this NESHAP no later than the compliance date, October 21, 2002.

State Rule Applicability - Individual Facilities

326 IAC 2-4.1 (New Source Toxics Control)

326 IAC 2-4.1 (New Source Toxics Control) does not apply to this facility as it is subject to 40 CFR Part 63 Subparts I, H, and GGG.

326 IAC 7 (Sulfur Dioxide Emission Limitation)

The process tanks have the potential to emit more than twenty-five (25) tons per year or ten (10) pounds per hour of sulfur dioxide. However, there are no applicable limits for the operations conducted in these tanks. Therefore, 326 IAC 7 does not apply.

326 IAC 8-5-3 (Miscellaneous Operation: Synthesized Pharmaceutical Manufacturing Operations)

This rule applies to the manufacture of pharmaceutical products by chemical synthesis. This section applies to all facilities emitting volatile organic compounds, including reactors, distillation units, dryers, storage of organic compounds , transfer of organic compounds, extraction equipment, filters, crystallizers, and centrifuges that have the potential to emit 15 pounds per day or more. The sections that are applicable to Lilly are (b)(1), (5) and (6).

Section (b)(1) of this rule requires that the VOC emissions coming from all reactors, distillation operation, crystallizers, centrifuges, and vacuum dryers shall be controlled by condensers or equivalent controls. The approximate control efficiency required by 326 IAC 8-5-3(b)(1) when using acetone, which has the worst volatility is around 90%.

Lilly is in compliance with this section of the rule, controlling the VOC emissions using either condensers in series with the Regenerative Thermal Oxidizer (RTO), or using the RTO alone. Lilly typically uses the existing RTO to control point source VOC emission from the tanks. The RTO, which has been demonstrated to achieve VOC removal efficiency in excess of 95%, will meet and exceed the requirement of the rule. If the RTO cannot be used due to safety issues, an alterative control device may be used. An analysis to demonstrate the alternative controls are equivalent controls will be done before they are used. Lilly would like to continue manufacturing operations in the process vessels included in this application using other existing pollution control equipment that complies with 326 IAC 8-5-3.

Section(b)(5) of this rule requires the owner or operator to install covers on all in process tanks that contain VOC's. Lilly complies with this section by using covers on all in process tanks, these covers are closed unless production sampling, maintenance, or inspection procedures require operator access.

Section (b)(6) of this rule requires the owner or operator to repair all visible leaks containing VOC. The repair shall be completed the first time the equipment is off line for a period of time long enough to complete the repair.

Compliance Requirements

Permits issued under 326 IAC 2-7 are required to ensure that sources can demonstrate compliance with applicable state and federal rules on a more or less continuous basis. All state

and federal rules contain compliance provisions, however, these provisions do not always fulfill the requirement for a more or less continuous demonstration. When this occurs IDEM, OAQ, in conjunction with the source, must develop specific conditions to satisfy 326 IAC 2-7-5. As a result, compliance requirements are divided into two sections: Compliance Determination Requirements and Compliance Monitoring Requirements.

Compliance Determination Requirements in Section D of the permit are those conditions that are found more or less directly within state and federal rules and the violation of which serves as grounds for enforcement action. If these conditions are not sufficient to demonstrate continuous compliance, they will be supplemented with Compliance Monitoring Requirements, also Section D of the permit. Unlike Compliance Determination Requirements, failure to meet Compliance Monitoring conditions would serve as a trigger for corrective actions and not grounds for enforcement action. However, a violation in relation to a compliance monitoring condition will arise through a source's failure to take the appropriate corrective actions within a specific time period.

The compliance monitoring requirements applicable to this modification are as follows:

The process tanks TK 47-3 and TK 35-3 have applicable compliance monitoring conditions as specified below:

(a) the Regenerative Thermal Oxidizers (RTO) or Condensers (when Lilly elects to control the VOC by condensers) shall operate at all times the equipment being controlled are in operation;

(b) when the VOC emissions from the proposed general process tanks including the existing facilities are controlled by the RTO, the RTO's operating temperature shall be maintained at 1600^0F, or the temperature determined during the most recent stack tests, to maintain at least 90% destruction of the volatile organic compounds. The operating temperature of the RTO shall be recorded and monitored continuously;

(c) when the VOC emissions from the proposed general process tanks including the existing facilities are controlled by the condensers, the outlet gas temperature shall be equal to or less than that specified by 326 IAC 8-5-3;

(d) the Permittee shall record the times during which the RTO or condensers, serving the proposed process tank, including the existing facilities, were not operated although the proposed equipment was emitting VOCs;

(e) the Permittee shall record the reason the RTO or condensers were not operated during the periods described in (d);

(f) the Permittee shall record the corrective actions taken to bring the RTO or condensers to normal operation during the periods described in (d);

(g) the Permittee shall record the number of hours the proposed process tanks, including the existing facilities were emitting VOC but were vented to points other than the RTO or a condenser complying with 326 IAC 8-5-3;

(h) The owner or operator shall implement the Lilly Leak Detection and Repair (LDAR) Program, most recently approved by the Office of Air Quality, to reduce fugitive emissions from processes that use methylene chloride. If it is not feasible to either pressure test a group of fugitive sources or monitor a specific compound, then a written justification will be required for each source or compound exempted from testing. Any necessary adjustments to the procedures shall be submitted to the Office of Air Quality for approval prior to implementation.

(i) The replacement tanks are subject to 40 CFR Part 63, Subpart GGG (National Emissions Standard for Pharmaceutical Production) and shall be in compliance with this NESHAP by the compliance date.

Conclusion

The construction of this proposed modification shall be subject to the conditions of the attached proposed Part 70 Minor Source Modification No. 157-14265-00006.

Emissions Calculations

Source Location: 1650 Lilly Road, Lafayette, Indiana 47909
County: Tippecanoe
SIC Code: 2834 & 2879
Operation Permit No.: TV 157-6879-00006
Operation Permit Issuance Date: Pending
Minor Source Modification No.: 157-14265-00006
Permit Reviewer: ERG/MP

Eli Lilly and Company has submitted an application relating to the replacement of two process tanks, identified as TK 47-3 and TK 35-3, both in building T27. The volatile organic compounds (VOC) emissions from these tanks will be controlled directly by the existing Regenerative Thermal Oxidizer (RTO) permitted under Construction Permit CP157-1980.

The point source emissions from these process vessels may vent directly to the RTO, or they may first vent to scrubbers, process control condensers, vacuum sources, or through other process vessels before going to the RTO. If venting the process vessel to the RTO would cause a safety concern, the process vessels may vent to an alternative pollution control device. Also, in the event that the RTO is unavailable, Lilly would continue manufacturing operations in the process vessels using other existing pollution control equipment that complies with 326 IAC 8-5-3. The carbon monoxide emissions from these replacement tanks will be voluntarily controlled by the RTOs. The sulfur dioxide emissions from these tanks will be voluntarily controlled by scrubbers. The nitrogen oxides emissions from these replacement tanks will be voluntarily controlled by scrubbers.

Potential emissions from these tanks are:

Potential to Emit (tons/year)						
Proposed Process Tanks	Capacity (Gallons)	VOC & Org. HAPs	CO	SO_2	NOx	Inorganic HAPs*
T27 Gen'l TK TK 47-3	2000	41.61	39.55	60.6	3.39	24
T27 Charge Tank TK 35-3	1000	22.66	19.77	30.3	1.70	12
TOTAL		64.27	59.32	90.9	5.09	36

* HCl (gas)

Process Description:

The process vessels can be used in a variety of operations involved in pharmaceutical manufacturing. These operations can be of batch or continuous nature and include, but are not limited to: heating, cooling, distilling (atmospheric and vacuum), extracting, crystallizing, chemical synthesis, cryogenic service, and their associated operations.

The process used to model the emissions from the general process vessels is a worst case process designed to give a maximum emissions estimate for any process that may be run in this piece of equipment. While general process vessels are only used in the production of bulk pharmaceutical drugs, the type of products manufactured will vary with the market demand.

Emissions calculations for point source VOC emissions from all tanks were performed by the applicant, using the equations found in the EPA guideline for control of volatile organic compounds emissions from manufacture of synthesized pharmaceutical products, EPA-450/2-

78-029. To estimate the maximum potential uncontrolled and allowable VOC emissions for each piece of equipment, acetone was used as solvent in the emission calculations and 8760 hours/year operating schedule was assumed to get a worst case potential emissions scenario. Acetone although a non-photochemically reactive hydrocarbon, was used in the calculations because it has the highest volatility among the solvent utilized. Since solvents with vapor pressures as high as that of acetone are not always used in the processes, the assumption used in the calculations will generate a worst case estimate for the potential VOC emissions.

For this application, the VOC emissions estimate from all tanks is based on a combination of the typical unit operations that are done to perform a process. The process steps in the model for tanks include charging, heating, atmospheric and vacuum distillations. The process used to model the VOC emissions from the tanks is a worst case process designed to give a maximum emissions estimate for any process that may be run in the tank. For example, a distillation process can include a tank evacuation, a heating, and distillation steps.

The emission calculations assume the control device is a condenser with exit gas temperature of -15EC. This demonstrates that the control efficiency required to comply with 326 IAC 8-5-3 is approximately 90%. The RTO is designed to achieve more than 95% reduction of the VOC emissions which will meet the requirements of 326 IAC 8-5-3. When condensers are used to control VOC emissions, these condensers will achieve an efficiency of 90%. The various assumptions used in calculating emissions from different process activities may be found with the relevant equations in the sample calculations. For this application, the process tank VOC emission estimates are based on a combination of the typical unit operations that are done to perform a process. The steps in the model process include charging, heating, tank evacuation with vacuum distillations, and atmospheric distillations. For example, a distillation process can include a tank evacuation, a heating step, and a distillation step. For all processes, acetone a non-photochemically reactive hydrocarbon was used in the calculations, since it has the highest volatility among the solvent being utilized.

During distillation operations, the condenser on a process vessel is not considered to be a pollution device. It is classified as a process control device because it is vital to production of the normal product of the distillation. No other process operations will have condensers as the pollution control device.

The calculations for the controlled point source VOC emissions from the process tank assumes that the pollution control device is a condenser (exit gas temperature -15EC). The VOC emissions leaving the condensers are calculated assuming ideal liquid and vapor in equilibrium at a given temperature and pressure.

Potential uncontrolled fugitive emissions were estimated using SOCMI factors by the applicant (see attached spreadsheet).

Process Vessel VOC Calculation Assumptions:

1. Pure acetone used as the VOC in all calculations

2. The vessel contains perfectly mixed ideal liquid and vapor phases, and they are continuously in phase equilibrium.

3. The vapor leaving the vessel is assumed to have the same composition as the vapor in the tank's vapor space.

4. The streams leaving the condensers, where used, are calculated assuming ideal liquid and vapor in equilibrium at the given temperature and pressure.

5. It is assumed that the amount of liquid being vaporized in the tank is small when compared to the total liquid volume. Therefore, the liquid composition and the volume of the vapor space can be assumed to be constant.

6. The control device is a condenser that will produce an exit gas temperature of -15EC (per 326 IAC 8-5-3 for acetone)under all loading, or an equivalent control device that will have the same control efficiency as this condenser.

7. VOC emissions are from the tanks themselves, not ancillary existing equipment.

8. Nitrogen purge rate for inerting purposes is 5 scfh.

9. Charging into a tank is at 60 gallons per minute.

10. Tanks are charged 2/3 full of acetone for all tank sizes.

11. The tank is assumed to start each operation 2/3 full, except for "Charging" where the tank is empty at the start. The vapor space is assumed to be composed of gaseous N_2 in equilibrium with acetone vapor at the stated temperature.

12. The atmospheric distillation involves heating the tank contents (pure acetone) to its boiling point, then distilling over 1/2 of the liquid volume.

13. During the atmospheric distillation, there are two condensers. The first is a process control condenser that produces an exit gas temperature of 23EC(55EF cooling water = 12.78EC + 10EC approach = 22.78 ~ 23EC). The emissions from this condenser are listed in the potential uncontrolled column. The second is an emissions control condenser that produces an exit gas temperature of -15EC, or a control device with the same control efficiency. The emissions from this condenser are listed in the potential controlled column.

14. There is a 5 scfh nitrogen purge during all atmospheric distillations.

15. "Evacuation" means evacuating the tank from atmospheric pressure down to 1 mmHg above the vapor pressure of acetone at 20EC.

16. The vacuum distillation inert leak rate is 0.5 scfm for all tank sizes and vacuum levels. This is the average leak rate.

17. The vacuum distillation involves evacuating the tank from atmospheric pressure to acetone's vapor pressure at 20EC, then distilling over 1/2 of the liquid volume.

18. During the vacuum distillation, there are two condensers. The first is a process control condenser that produces an exit gas temperature of 0EC (-10EC brine + 10EC approach = 0EC). The emissions from this condenser are listed in the potential uncontrolled column. The second is an emissions control condenser that produces an exit gas temperature of -15EC, or a control device with the same control efficiency. The emissions from this condenser are listed in the allowable column.

19. The pressure transfer operation consists of pressuring-up the tank with nitrogen from 1 to 2 atmospheres to force the liquid out of the tank. When the tank is empty, this pressure is released from the tank.

20. There are no process condensers on the purge, charge, heat from 20EC to 55EC, evacuation, or de-pressurization steps. A condenser is not needed to perform these operations.

21. It is assumed that during the time the tank is not performing a set of steps that it can be doing another operation that the 24 hour sweep will account for that operation's emissions, i.e., stirring, cooling.

22. "Per step" emissions are for performing the given step, or series of steps, once.

23. "Yearly" emissions are for performing the given step, or series of steps, once per day, 365 days per year.

24. For the sets of steps listed under "potential process chain for 1 day", each set is performed independently of the previous and next set of steps. The time required to perform each set of steps is also listed, then summed. It is also assumed that this process chain is only performed once per day.

25. These examples calculations are for a 2,000 gallon tank.

Calculation Nomenclature

a,b,c	-	Antoine coefficients
i	-	The i th. component
K_{ideal}	-	Vapor/liquid equilibrium constant
LMPD	-	Log mean pressure difference (mm Hg)
L	-	Total moles in liquid phase (lb-mole)
L_i	-	Moles of component i in liquid phase (lb-mole)
M	-	Mass(lb)
M_i	-	Mass of component i (lb)
m	-	Mass rate (lb/hr)
m_i	-	Mass rate of component i (lb/hr)
MW	-	Molecular weight (lb/lb-mole)
MW_i	-	Molecular weight of component i (lb/lb-mole)
N or V	-	Total moles in vapor phase (lb-mole)
n	-	Molar rate (lb-mole/hr)
N_i or V_i	-	Moles of component i in vapor phase (lb-mole)
n_i	-	Molar rate of component i (lb-mole/hr)
P or P_{total}	-	Total Pressure (mm Hg)
Pi	-	Partial pressure of component i (mm Hg)
p^0	-	Vapor pressure (mm Hg)
p_i^0	-	Vapor pressure of component i (mm Hg)
R	-	Ideal Gas Constant (10.73 ft^3 psia/lb-mole ^{0}R)
T	-	Temperature in Kelvin (K) or Rankine(ER)
t	-	Temperature in Celsius (EC) or Fahrenheit (EF)
V	-	Volume (ft^3)
V or N	-	Total moles in vapor phase (lb-mole)
V_i or N_i	-	Moles of component i in vapor phase (lb-mole)
v	-	Volumetric rate (gpm for liquid, cfm for vapor or gas)
x_i	-	Liquid mole fraction of component i
y_i	-	Vapor mole fraction of component i
Z	-	Total moles entering condenser (lb-mole)
Z_i	-	Total moles of component i entering condenser (lb-mole)

Sample calculations for VOC emissions:

Physical Properties:
Acetone:

Molecular weight = 58.08
Antoine Coefficients (-59.4EC to 56.5EC)

a = 16.82
b = 2993
c = -35.63
Specific gravity @ 20EC = 0.792

Nitrogen(gaseous):
Molecular weight = 28

Possible Operation Step A: N_2 inerting purge @ 5 scfh

Tanks that contain a flammable liquid(s) or a VOC(s) are purged with gaseous N_2 to keep the vapor space above the liquid inert. As a continuous stream of N_2 flows into the tank, N_2 becomes saturated with vapor that is in equilibrium with the liquid. An emission is created as this N_2/vapor mixture leaves the tank.

Liquid temperature = 293.15E K (20EC)
Vessel Pressure = 760 mm Hg

Pure acetone is in the tank during this step, so the mole fraction of liquid component (x_A) is 1.

Potential uncontrolled VOC emissions:

Vapor pressure calculation: Using the Antoine Equation at liquid temperature (20EC),

$$\ln(pA^O) = [a-(b/(T(^0K)+c)]$$
$$pA^O \text{ (mmHg)} = \exp [a-(b/(T(^0K) + c))]$$
$$= \exp [16.82 - (2993/(293.15 - 35.63)]$$
$$= 180.84 \text{ mmHg}$$

Equilibrium Concentration: Raoult's Law states that the partial pressure of acetone, P_A, can be calculated by multiplying the vapor pressure, pA^O, by the liquid mole fraction, x_A, which equals the total pressure, P, multiplied by the vapor mole fraction, y^A.

$$(P)(y_A) = (pA^O)(x_A) = P_A$$

Rearranging yields:

$$y_A/x_A = pA^O/P = K_{ideal}$$
$$y_A = (K_{ideal})(x_A)$$
$$= (180.84/760)(1)$$
$$= 0.2379$$

Inert Sweep Rate: It is assumed that the amount of N_2 entering the tank leaves the tank at the same rate. It is assumed that the N_2 stream enters the tank at 70EF (530^0R) and 14.72 psia. Using the ideal gas law;

PV = nRT
PV = (m/MW)RT Since: n = m/MW
m = PV(MW)/RT

The mass flow rate, m, is:

$$m_{n2}\ (lb/hr) = \frac{v(cfh)(MW_{N2})(14.72\ psia)}{(R)(530^0R)}$$

$$= \frac{(5\ scfh)(28)(14.72\ psia)}{(10.73)(530^0R)}$$

$$= 0.3624$$

For 24 hours:

$MN_2(lb) = (0.3624\ lb/hr)\ (24\ hrs) = 8.70\ lb$

Mass of acetone leaving the system: The number of moles of volatile components leaving the tank is related to the number of moles leaving the system and the partial pressure of the volatile and inert compounds. For a one component system:

$$(P_A)(v) = (n_A)(R)(T)$$

For the inert sweep, v, R, and T are assumed constant. Therefore, the ratio of moles of inert to volatile compounds can be calculated as:

P_A/P_{N2}	=	n_A/n_{N2}	
P_A/P_{N2}	=	$(n_A)\ (MW_{N2})/m_{N2})$	Since: $n_{N2} = m_{N2}/MW_{N2}$
P_A/P_{N2}	=	$(m_A)\ (MW_{N2})/m_{N2})\ (\ MW_A)$	Since: $n_A = m_A/MW_A$
$P_A/(P\text{-}P_A)$	=	$(mA)(MW_{N2})/(m_{N2})(MW_A)$	Since: $P_{N2} = P\text{-}P_A$

The mass rate of acetone vapor emitted by the N_2 sweep is:

$m_A(lb/hr) = (M_{N2}/MW_{N2})(MW_A)(P_A/(P_A\text{-}P))$
$= (0.3624/28)(58.08)(180.84/(760\text{-}180.84))$
$= 0.2347\ lb/hr$

For 24 hours: $M_A(lb) = (0.2347\ lb/hr)(24\ hrs)$
$= 5.63\ lb$

Maximum controlled VOC emissions (per 326 IAC 8-5-3):

Potential controlled emissions are based on emissions from the emission control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of -15EC, to ensure compliance with 326 IAC 8-5-3 for acetone.

Vapor pressure calculation: Using the Antoine Equation at -15EC,

ln (pAE(mmHg))	= [a-(b/(T(EK)+c))]
pAE(mmHg)	= exp [a-(b/(T(EK) + c)]
	= exp [16.82 - (2993/(258.15 - 35.63)]
	= 29.06
K_{ideal} = 29.06/760	= 0.0382

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser:

$$Z = V + L$$

Likewise for each component:

$$Z_i = V_i + L_i \qquad \text{Where Li = 0 for inert}$$

or

$$Z_i = (V)(y_i) + (L)(x_i) \qquad \text{for volatile compounds}$$

$$Z_i = (V)(y_i) \qquad \text{for inert compounds}$$

$$Z_i = (V)(K_{ideal})(x_i) + (L)(x_i) \qquad \text{Since } K_{ideal} = y_i/x_i$$

$$Z_i/L = (V/L)(K_{ideal})(x_i) + (x_i)$$

$$Z_i/L = [(V/L)(K_{ideal}) + 1\ ]$$

$$Z_i/[(V/L)(K_{ideal}) + 1\ ] = (L)(x_i) = L_i$$

$$L_i = Z_i/[(V/L)(K_{ideal}) + 1\ ]$$

To solve the mass balance for the number of moles in the liquid and vapor phases:

1. Assume a V/L ratio(where V is total molar volume including the inert gases)

2. Calculate the liquid moles of each volatile component by:

$$L_i = Z_i/[(V/L)(K_{ideal}) + 1\ ]$$

3. Calculate the vapor moles of each volatile component by:

$$Vi = Z_i - L_i$$

4. The moles of inert out of the condenser is equal to the moles into the condenser, which has been calculated previously.

5. Sum the volatile component liquid moles (L) and the volatile and inert component vapor moles (V) and compute the ratio V/L.

6. The computed V/L is compared to the assumed V/L. If they are not equal, a new iteration is performed using the calculated V/L.

The following table shows the values used for the iteration:

Iteration	Assumed V/L	Calculated		VN2	Calculated V/L
		LA	VA		
1	0.50	0.0952	0.0018	0.3106	3.28
2	3.28	0.0862	0.0108	0.3106	3.73
3	3.73	0.0849	0.0121	0.3106	3.8
4	3.80	0.0847	0.0123	0.3106	3.81
5	3.81	0.0847	0.0123	0.3106	3.81

The mass of each component is related to its moles by:

$M_i(lbs) = (V_i)(MW_i)$
$M_A(lbs) = (0.0123)(58.08)$
$= 0.71$ lb

Possible operation Step B: Charge 2000 gallon tank 2/3 full:

This calculation models the emissions associated with the displacement of vapor from a tank that is being filled with a VOC. The tank in this case is filled 2/3 full with acetone at 20EC at 60 gallons per minute. The tank is assumed to be filled with gaseous N_2 before charging, and the displaced vapor is N_2, 100% saturated with acetone.

Liquid temperature = 293.15K (20EC)
Tank pressure = 760 mmHg

Pure acetone is charged into the tank during this step, so the mole fraction of liquid component (x_A) is 1.

Potential VOC emissions:

Volume of charged material:

V_L = (2000 gallons)(2/3) = 1,333.33 gallons
= (2000 gal)($1ft^3$/7.4805 gal)(2/3) = 178.24 ft^3

This is also the volume of inert being displaced.

Molar displacement rate of inert:

The volatile and inert vapor partial pressures are related by:

$$P_{Total} = P_A + P_{N2}$$

The partial pressure of N_2 is then:

$P_{N2} = P_{Total} - P_A$
= (760)- (180.84)
= 579.16 mmHg
= (579.16 mmHg)(14.696 psia/760 mmHg)
= 11.20 psia

Applying Dalton's Law:

$$n_{N2} = (P_{N2})(V_L)/[(R)(T)]$$
$$= \frac{(11.20 \text{ psia})(178.24 \text{ ft3})}{((10.73)(527.67))}$$
= 0.3526 lbmoles

Mass of Acetone leaving the tank:

The mass rate of acetone vapor emitted by the liquid displacement:

$M_A(lb) = (M_{N2})(MW_A)(P_A / P_{N2})$
$= (0.3526)(58.08)(180.84)/(579.16)$
$= 6.39$ lbs

Maximum controlled VOC emissions under rule 326 IAC 8-5-3:

Potential controlled VOC emissions are based on emissions from the control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of -15EC. The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser. This calculation is identical in method to Step A's (N_2 inerting purge @ 5 scfh) Potential Controlled calculation method.

The resulting VA of the iterative calculation is: 0.0140

The mass of each component is related to its moles by:

$M_i(lbs) = (V_i)(MW_i)$
$M_A(lbs) = (0.014)(58.08)$
$= 0.81$ lbs

Possible operation Step C: Heat tank contents from 20EC to 55EC:

This calculation models the emissions associated with the displacement of vapor from acetone that is being heated from 20EC to 55EC. The vapor space above the liquid is assumed to consist of gaseous N_2 saturated with acetone vapor. As the liquid heats up, it vaporizes and displaces the vapor above it, causing an emission from the tank.

Initial liquid temperature = 293.15K (20EC, 527.67ER)
Final liquid temperature = 328.15K (55EC, 626.67ER)
Tank pressure = 760 mmHg

Volume of acetone in tank:

$V_L = (2000 \text{ gallons})(1 \text{ ft}^3/7.4805 \text{ gal})(2/3) = 178.24 \text{ ft}^3$

Volume of vapor space:

$V_{VS} = (2000 \text{ gallons})(1 \text{ ft}^3/7.4805 \text{ gal})(1/3) = 89.12 \text{ ft}^3$

Pure acetone is in the tank during this step, so the mole fraction of liquid component (x_A)is 1.

Potential VOC emissions:

Vapor Pressures: Initial and final vapor pressures are calculated using the Antoine equations as previously shown.

Initial:

Acetone, pEA,I = 180.84 mmHg (3.50 psia) K_{ideal},I = 0.2379
Nitrogen, pEN_2,I = 579.16 mmHg (11.20 psia)

Final:

Acetone, pEA,F = 726.49 mmHg (14.05 psia) K_{ideal},F = 0.9559
Nitrogen, pEN_2,F = 33.51 mmHg (0.65 psia)

Change in moles of inert in vapor space between initial and final conditions:

$$NN_2,I - NN_2,F = \left[\frac{(P_{N2},I)}{(T_I)} - \frac{(P_{N2},F)}{(T_F)} \right] (VVS)/(R)$$

$$= \left[\frac{(11.20)}{(527.67)} - \frac{(0.65)}{(626.67)} \right] (89.12)/(10.73)$$

$$= 0.1677 \text{ lbmoles}$$

Amount of acetone being displaced from the tank:

The total number of moles in the vapor space and the vapor phase composition are both functions of temperature. Since the molar rate at which vapors leave the tank is greatly influenced by the components partial pressure, it is assumed that for any component:

$$N_i / (LMPD)_i = \text{Constant}$$

Where N_i is the number of moles of component i having left the tank.

The Log Mean Pressure Difference of i, (LMPD)i, is calculated as follows:

$$(LMPD)_i = (P_I - P_F)i / \ln(P_I/P_F)i$$
$$(LMPD)_A = (180.84 - 726.49)_A / \ln(180.84/726.49)_A$$
$$= 392.38$$
$$(LMPD)_{N2} = (579.16 - 33.51)_{N2} / \ln (579.16/33.15)_{N2}$$
$$= 190.75$$

Therefore, the number of moles of acetone can be estimated by:

$$N_A = (N_{N2})(LMPD)_A /(LMPD)_{N2}$$

And the mass of acetone leaving the tank is:

$$M_A \text{ (lbs)} = (N_{N2})[(LMPD)_A /(LMPD)_{N2}](MW_A)$$
$$= (0.1677)[(392.38)/(190.75)](58.08)$$
$$= 20.04 \text{ lb}$$

Maximum Controlled VOC Emissions (under 326 IAC 8-5-3):

Potential controlled VOC emissions are based on emissions from the control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of -15EC.

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser. This calculation is identical in method to Step A's (N_2 inerting purge @ 5 scfh) Potential controlled calculation method.

The resulting V_A of the iterative calculation is: 0.0067

The mass of each component is related to its moles by:

M_i (lbs) = $(V_i)(MW_i)$
M_A (lbs) = (0.0067)(58.08)
= 0.39 lbs

Possible Operation Step D: Atmospheric Distillation

The atmospheric distillation involves heating the tank contents (pure acetone) to its boiling point, then distilling over 1/2 of the liquid volume. During the atmospheric distillations, there are two condensers. The first is a process control condenser that produces an exit gas temperature of 23EC (55EF cooling water = 12.78EC + 10EC approach = 22.78EC ~ 23EC). The second is an emission control condenser that produces an exit gas temperature of -15EC, or a control device with the same control efficiency.

Heating acetone to its boiling point is modeled using the method outlined in Step C (Heat tank contents from 20EC to 55EC). The distillation is modeled using the method outlined in Step A (N_2 inerting purge @ 5 scfh) with an additional "potential controlled emissions" calculation because there are two condensers as explained above.

Possible Operation Steps E & F: Vacuum Distillation

The Vacuum distillation involves evacuating the tank from atmospheric pressure to acetone's vapor pressure at 20EC , then distilling over 1/2 of the liquid volume. Because the system is under vacuum, and it is not perfectly sealed, air leaks into the system. During the vacuum distillation, there are two condensers. The first is a process control condenser that produces an exit gas temperature of 0EC (-10EC brine + 10EC approach = 0EC). The second is an emission control condenser that produces an exit gas temperature of -15EC, or a control device with the same control efficiency.

Evacuating the tank to acetone's boiling point (at 20EC) is modeled using the method outlined below. The air leakage during the distillation is modeled using the method outlined in Step A (N_2 inerting purge @ 5 scfh) with an additional "potential controlled emissions" calculation because there are two condensers as explained above.

Liquid temperature = 293.15 K (20EC, 527.67ER)
Initial tank pressure = 760 mmHg

Volume of acetone in tank:

V_L = (2000 gallons)(2/3) = 1,333.33 gallons
= (2000 gallons)(1 ft^3/7.4805 gallons)(2/3) = 178.24 ft^3

Volume of vapor space:

V_{VS} = (2000 gallons)(1/3) = 666.67 gallons
= (2000 gallons)(1 ft^3/7.4805 gallons)(1/3) = 89.12 ft^3

Pure acetone is in the tank during this step, so the mole fraction of liquid component (X_A) is 1.

Potential VOC emissions:

Vapor Pressures: Calculated using the Antoine equations as previously shown.

Initial:

Acetone, p^0A,I = 180.84 mmHg K_{ideal},A = 0.2379
Nitrogen, p^0N_2,I = 579.16 mmHg

Mass of N_2 evacuated from tank: Since the vapor pressures of acetone and N_2 are constant, as well as the vapor space and temperature, the moles of acetone also remain constant, i.e., as any acetone vapor leaves the system, it is replaced by an equal amount from the liquid phases. The decrease in pressure, therefore, is due to the evacuation of N_2. The number of moles of N_2 leaving the system are calculated by:

$$(N_{N2},\text{Initial} - N_{N2},\text{Final}) = (P_{\text{Initial}} - P_{\text{Final}})(V_{VS})/[(R)(T)]$$

$$= \frac{(14.696 - 3.5)(89.12)}{(10.73)(527.67)}$$

$$= 0.1762 \text{ lbmoles}$$

Mass of Volatiles evacuated from tank: Using the LMPD method as described in Step C (Heat tank contents from 20EC to 55EC) the mass of acetone leaving the tank is calculated by:

$(LMPD)N_2 = (P_I - P_F)N_2 / \ln(P_I/P_F)N_2$

$(LMPD)N_2 = (579.16 - 0.16)N_2 / \ln(579.16/0.16)N_2$

$= 70.66$

M_A (lbs) $= [(N_{N2})/(LMPD)N_2](MW_A)(P_A)$

$= [(0.1762)/(70.66)](58.08)(180.84)$

$= 26.19$ lb

Maximum Controlled VOC Emissions (under 326 IAC 8-5-3):

Potential controlled emissions are based on emissions from the control device. In these calculations it is assumed to be a surface condenser that produces an exit vapor temperature of -15EC.

The total number of moles entering the condenser is equal to the sum of the liquid and vapor moles leaving the condenser. This calculation is similar to Step A's (N_2 inerting purge @ 5 scfh) potential controlled calculation method.

The resulting V_A of the iterative calculation is: 0.0337

The mass of each component is related to its moles by:

$M_i(\text{lbs}) = (V_i)(MW_i)$

$M_A(\text{lbs}) = (0.0337)(58.08)$

$= 1.96$ lb

A summary of the potential VOC emissions for each of these tanks follows:

1,000 Gallon Tank (TK 47-3)

Possible Operation Steps	Temp (C)	VOC Emissions Per Step, pounds	
		PU*	PC*
A. N2 Inerting Purge @5 scfh	20	5.73	0.73
B. Charge 1000 gal tank 2/3 ful of Acetone	20	3.20	0.41
C. Heat from 20 C to 55 C	20-55	9.94	0.19
Atmospheric Distillation D. Heat from 20 C to 56.3 C 5 scfh N2 purge during distillation	 20-56.3 56.3	 23.19 0.86	 0.20 0.09
Vacuum Distillation E. Evacuation F. Sweep (0.5 scfm leak rate)	 20 20	 13.07 8.21	 0.98 2.62
G. Depressurization from 2 to 1 atmospheres	20	4.02	0.80

* PU = Potential Uncontrolled, PC = Potential Controlled (8-5-3)

Possible Process Chain for 1 Day	Step(s)	VOC Emissions Per Step, pounds			
		Per Step, pounds		Yearly, pounds	
		PU	PC	PU	PC
1. Charge - Vac. Dist. - Depressurize	B-E-F-G	28.50	4.80	10401.98	1753.70
2. Charge - Atm. Dist. - Depressurize	B-D-G	31.26	1.50	11410.91	548.62
3. Charge - Heat - Depressurize	B-C-G	17.16	1.40	6263.37	511.45
4. Charge - Heat - Depressurize	B-C-G	17.16	1.40	6263.37	511.45
5. Charge - Nothing - Depressurize	B-G	7.22	1.21	2633.51	441.00
6. 24 hour sweep	A	5.73	0.73	2092.69	266.5
Total (pounds)		107.03	11.04	39065.83	4032.72
Total (tons)		0.05	0.01	19.53	2.02

2,000 Gallon Tank (TK 35-3)

Possible Operation Steps	Temp (C)	VOC Emissions Per Step, pounds	
		PU*	PC*
A. N2 Inerting Purge @5 scfh	20	5.73	0.73
B. Charge 1000 gal tank 2/3 ful of Acetone	20	6.39	0.81
C. Heat from 20 C to 55 C	20-55	19.89	0.39
Atmospheric Distillation D. Heat from 20 C to 56.3 C 5 scfh N2 purge during distillation	 20-56.3 56.3	 46.39 1.72	 0.41 0.18
Vacuum Distillation E. Evacuation F. Sweep (0.5 scfm leak rate)	 20 20	 26.15 16.42	 1.96 5.24
G. Depressurization from 2 to 1 atmospheres	20	8.04	1.60

* PU = Potential Uncontrolled, PC = Potential Controlled (8-5-3)

Possible Process Chain for 1 Day	Step(s)	VOC Emissions Per Step, pounds			
		Per Step, pounds		Yearly, pounds	
		PU	PC	PU	PC
1. Charge - Vac. Dist. - Depressurize	B-E-F-G	57	9.61	20,806.76	3,507.68
2. Charge - Atm. Dist. - Depressurize	B-D-G	62.54	3.01	22,826.27	1,097.40
3. Charge - Heat - Depressurize	B-C-G	34.33	2.8	12,529.02	1,023.03
4. Charge - Heat - Depressurize	B-C-G	34.33	2.8	12,529.02	1,023.03
5. Charge - Nothing - Depressurize	B-G	14.43	2.42	5,267.68	882.13
6. 24 hour sweep	A	5.73	0.73	2,092.69	266.5
Total (pounds)		208.36	21.37	76,051.44	7,799.77
Total (tons)		0.10	0.01	38.03	3.90

SO_2, NOx, CO, and inorganic HAP calculations

SO_2, Nox, and CO emissions may also be emitted from the process vessel Gen'l TanksTK 47-3 and 35.3. There may be processes run where one or more of these pollutants is emitted from a gas evolving process step. Based on Lilly's current knowledge of the processes run at Tippecanoe Laboratories, three different reactions were chosen to obtain an estimate of the potential SO2, NOx, and CO emissions. Each reaction is the highest known emitter of the respective pollutant it emits. There are fewer processes that emit SO_2, NOx, and CO than VOCs. Therefore, 100 lots/yr were used in the worst-case potential emission calculation. This maximum emission rate is much higher than any one tank will emit by itself, but it is difficult to estimate how much of the emissions can be attributed to each individual tank. Therefore, the air emission inventory indicates that the entire building emission comes from each tank by itself.

When summing the total emissions, this factor is taken into account by looking at the maximum emitting tank for Building T27.

Inorganic HAPs may be emitted from both tanks.

NOx - Tank 47-3

100 lots/yr for processes emitting NOx in T27.

Assumed all emissions can come from one tank or several tanks, but no more than a total of 100 lots/yr of any process that emits NOx will run in T27.

Since process stoichiometry is based on bulk facility building scale, scaled emissions from all process to appropriate size of new tanks.

Reaction 1:
$NaNO_2 + HCl \longrightarrow HNO_2 + NaCl$

92.3 kg of $NaNO_2$ will be reacted with HCl, therefore:
92.3 kg $NaNO_2$ (1000 g/1 kg)(1 mol/69 g $NaNO_2$) = 1338 mol $NaNO_2$

1338 mol Na NO_2 yields 1338 mol HNO_2

Reaction 2:
$N\text{-}NH_2 + HNO_2 \longrightarrow N\text{-}H + N_2O + H_2O$

Only half of the 1338 mol HNO_2 available reacts.
Therefore, 669 mol of N_2O are formed, 669 mol of HNO_2 remain.
Nitrous oxide (N_2O) is stable and inert.

Total NO_2 Formed:

669 mol NO_2	—>	669 mol NO_2
Formed from unreacted HNO_2		NO_2 evolved/lot

$$669\ \frac{\text{mol NO2}}{\text{lot}} \times \frac{46.01\ \text{g}}{\text{mol NO2}} \times \frac{1\ \text{lb}}{454\ \text{g}} \times \frac{100\ \text{lots}}{\text{year}} \approx 6780\ \frac{\text{lb NOx}}{\text{lot}}\ \text{(for a 2,000 gallon tank)}$$

Potential to Emit

T27 Gen'l Tank TK 47-3 (1,000 gallons)

$$\frac{6{,}780\ \text{lb NOx}}{\text{lot}} \times \frac{1{,}000\ \text{gallon}}{2{,}000\ \text{gallon}} \times \frac{1\ \text{ton}}{2{,}000\ \text{lbs}} \approx 1.70\ \frac{\text{tons NOx}}{\text{year}}$$

NOx - Tank 35-3

100 lots/yr for processes emitting NOx in T27.

Assumed all emissions can come from one tank or several tanks, but no more than a total of 100 lots/yr of any process that emits NOx will run in T27.

Since process stoichiometry is based on bulk facility building scale, scaled emissions from all process to appropriate size of new tanks.

Reaction 1:
$NaNO_2 + HCl \longrightarrow HNO_2 + NaCl$

92.3 kg of $NaNO_2$ will be reacted with HCl, therefore:
92.3 kg $NaNO_2$ (1000 g/1 kg)(1 mol/69 g $NaNO_2$) = 1338 mol $NaNO_2$

1338 mol Na NO_2 yields 1338 mol HNO_2

Reaction 2:
$N\text{-}NH_2 + HNO_2 \longrightarrow N\text{-}H + N_2O + H_2O$

Only half of the 1338 mol HNO_2 available reacts.
Therefore, 669 mol of N_2O are formed, 669 mol of HNO_2 remain.
Nitrous oxide (N_2O) is stable and inert.

Total NO_2 Formed:
669 mol NO_2 —> 669 mol NO_2
Formed from unreacted HNO_2 NO_2 evolved/lot

$$669 \frac{\text{mol NO2}}{\text{lot}} \times \frac{46.01\ \text{g}}{\text{mol NO2}} \times \frac{1\ \text{lb}}{454\ \text{g}} \times \frac{100\ \text{lots}}{\text{year}} \approx 6780 \frac{\text{lb NOx}}{\text{lot}} \text{ (for a 2,000 gallon tank)}$$

Potential to Emit

T27 Gen'l Tank TK 35-3 (2,000 gallons)

$$\frac{6{,}780\ \text{lb NOx}}{\text{lot}} \times \frac{1\ \textit{ton}}{2{,}000\ \textit{lbs}} \approx 3.39 \frac{\textit{tons NOx}}{\textit{year}}$$

SO2 - Tank 47-3

100 lots/yr for processes emitting SO_2 in T27.

Assumed all emissions can come from one tank or several tanks, but no more than a total of 100 lots/yr of any process that emits SO_2 will run in T27.

Since processes stoichiometry is based on bulk facility building scale, scaled emissions from all processes to appropriate size of the new tanks.

$$SOCl_2 + H_2O \longrightarrow SO_2 + 2HCl$$

$$1023 \frac{\text{kg } SOCl_2}{\text{lot}} \times \frac{\text{kgmol } SOCl_2}{118.97\text{kg}} \times \frac{\text{kgmol } SO_2}{\text{kgmol } SOCl_2} \times \frac{64.06\ \text{kg } SO_2}{\text{kgmol } SO_2} \times 2.2 \frac{\text{lb}}{\text{kg}}$$

$$\approx 1212 \frac{\text{lb } SO_2}{\text{lot}} \text{ (for a 2,000 gallon tank)}$$

Potential to Emit

T27Gen'l Tank TK 47-3 (1,000 gallons)

$$\frac{1{,}212\ \text{lb } SO_2}{\text{lot}} \times \frac{100\ \text{lots}}{\text{year}} \times \frac{1{,}000\ \text{gallon}}{2{,}000\ \text{gallon}} \times \frac{1\ \text{ton}}{2{,}000\ \text{lbs}} \approx \mathbf{30.30} \frac{\mathbf{tons\ SO_2}}{\mathbf{year}}$$

SO2 - Tank 35-3

100 lots/yr for processes emitting SO_2 in T27.

Assumed all emissions can come from one tank or several tanks, but no more than a total of 100 lots/yr of any process that emits SO_2 will run in T27.

Since processes stoichiometry is based on bulk facility building scale, scaled emissions from all processes to appropriate size of the new tanks.

$$SOCl_2 + H_2O \text{ —> } SO_2 + 2HCl$$

$$1023 \frac{\text{kg } SOCl_2}{\text{lot}} \times \frac{\text{kgmol } SOCl_2}{118.97\text{kg}} \times \frac{\text{kgmol } SO_2}{\text{kgmol } SOCl_2} \times \frac{64.06 \text{ kg } SO_2}{\text{kgmol } SO_2} \times 2.2 \frac{\text{lb}}{\text{kg}}$$

$$' 1212 \frac{\text{lb } SO_2}{\text{lot}} \text{ (for a 2,000 gallon tank)}$$

Potential to Emit

T27Gen'l Tank TK 35-3 (2,000 gallons)

$$\frac{1{,}212 \text{ lb } SO_2}{\text{lot}} \times \frac{100 \text{ lots}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} ' \mathbf{60.60} \frac{\mathbf{\text{tons } SO_2}}{\mathbf{\text{year}}}$$

CO - Tank 47-3

Based on test data from process with worst case CO emissions. The test data was performed on a 1:20,000 scale for a process run in a 2000 gallon scale building.

Process uses 63.5 grams of $COCl_2$
Assume all is converted to CO (this is a very conservative assumption)

$$63.5 \frac{\text{g } COCl_2}{\text{lot}} \times \frac{\text{gmol } COCl_2}{98.92 \text{ g}} \times \frac{\text{gmol CO}}{\text{gmol } COCl_2} \times \frac{28 \text{ g CO}}{\text{gmol CO}} \times \frac{1 \text{ lb}}{454 \text{ g}}$$

$$' 0.0396 \frac{\text{lb CO}}{\text{lot}}$$

Potential to Emit

T27Gen'l Tank TK 47-3 (1,000 gallons)

$$\frac{0.0396 \text{ lb CO}}{\text{lot}} \times \frac{20{,}000 \text{ bldg size}}{1 \text{ sample size}} \times \frac{100 \text{ lots}}{\text{year}}$$

$$\times \frac{1{,}000 \text{ gallon}}{2{,}000 \text{ gallon}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} ' \mathbf{19.80} \frac{\mathbf{\text{tons CO}}}{\mathbf{\text{year}}}$$

CO - Tank 35-3

Based on test data from process with worst case CO emissions. The test data was performed on a 1:20,000 scale for a process run in a 2000 gallon scale building.

Process uses 63.5 grams of $COCl_2$
Assume all is converted to CO (this is a very conservative assumption)

$$63.5 \frac{g\ COCl_2}{lot} \times \frac{gmol\ COCl_2}{98.92\ g} \times \frac{gmol\ CO}{gmol\ COCl_2} \times \frac{28\ g\ CO}{gmol\ CO} \times \frac{1\ lb}{454\ g}$$

$$' 0.0396 \frac{lb\ CO}{lot}$$

Potential to Emit

T27Gen'l Tank TK 35-3 (2,000 gallons)

$$\frac{0.0396\ lb\ CO}{lot} \times \frac{20{,}000\ bldg\ size}{1\ sample\ size} \times \frac{100\ lots}{year}$$

$$\times \frac{1\ ton}{2{,}000\ lbs} \mathbf{' 39.60 \frac{tons\ CO}{year}}$$

Inorganic HAP - Tank 47-3

Based on emission calculations for worst case inorganic HAP emitting process (emits 1829 lb HCI per lot from a 4,000 gallon tank).

Maximum production capacity is based on producing 50,000 kilos of final per year.

Potential to Emit

T27 Gen'l Tank TK 47-3 (1,000 gallons)

$$\frac{1{,}829\ lb\ HCl}{lot\ tech} \times \frac{1{,}000\ gallons}{4{,}000\ gallons} \times \frac{1\ lot\ tech}{1{,}108\ bkg\ tech} \times \frac{1.152\ bkg\ tech}{1.10\ kilo\ final} \times \frac{50{,}000\ kilos}{year\ max\ capacity} \times \frac{ton}{2{,}000}$$

$$' 11.89 \frac{ton\ HCl}{year}$$

NOTE: Emissions do not exactly match those in the table due to rounding in previous calculations

Inorganic HAP - Tank 35-3

Based on emission calculations for worst case inorganic HAP emitting process (emits 1829 lb HCI per lot from a 4,000 gallon tank).

Maximum production capacity is based on producing 50,000 kilos of final per year.

Potential to Emit

T27 Gen'l Tank TK 35-3 (2,000 gallons)

$$\frac{1{,}829 \text{ lb HCl}}{\text{lot tech}} \times \frac{2{,}000 \text{ gallons}}{4{,}000 \text{ gallons}} \times \frac{1 \text{ lot tech}}{1{,}108 \text{ bkg tech}} \times \frac{1.152 \text{ bkg tech}}{1.10 \text{ kilo final}} \times \frac{50{,}000 \text{ kilos}}{\text{year max capacity}} \times \frac{\text{ton}}{2{,}000}$$

$$' \ 23.77 \ \frac{\text{ton HCl}}{\text{year}}$$

NOTE: Emissions do not exactly match those in the table due to rounding in previous calculations

Equipment Leak Fugitives

Company Name: **Eli Lilly and Company**
Address City IN Zip: **1650 Lilly Road, Lafayette, Indiana 47909**
CP: **157-14265**
Plt ID: **157-00006**
Reviewer: **ERG/MP**
Date: **18-Sep-2000**

TK47-3 Tank Replacement Fugitive Emission Calculation

Fugitive Emission Componenet	Number of Components	Uncontrolled Emissions		Controlled Emissions		Annual Uncontrolled Emissions (tpy)	Annual Controlled Emissions (tpy)
		SOCMI Emission Facotr (lb/hr/component)	Daily Emission (lb/day)	LDAR Factors (lb/hr/component)	Daily Emission (lb/day)		
Tank Flanges	24	0.00183	1.0541	0.000697	0.4015		
Pumps & Agitators	1	0.108908	2.6138	0.004969	0.1193		
Liquid Valves	5	0.015653	1.8784	0.001459	0.1751		
Vapor Valves	2	0.012346	0.5926	0.000309	0.0148		
Press Relief Valves	2	0.229281	11.0055	0.229281	11.0055		
Total VOC Fugitive Emissions			17.1443		11.7161	3.1288	2.1382

TK 35-3 Tank Replacement Fugitive Emission Calculation

Fugitive Emission Componenet	Number of Components	Uncontrolled Emissions		Controlled Emissions		Annual Uncontrolled Emissions (tpy)	Annual Controlled Emissions (tpy)
		SOCMI Emission Facotr (lb/hr/component)	Daily Emission (lb/day)	LDAR Factors (lb/hr/component)	Daily Emission (lb/day)		
Tank Flanges	21	0.00183	0.9223	0.000697	0.3513		
Pumps & Agitators	2	0.108908	5.2276	0.004969	0.2385		
Liquid Valves	5	0.015653	1.8784	0.001459	0.1751		
Vapor Valves	2	0.012346	0.5926	0.000309	0.0148		
Press Relief Valves	2	0.229281	11.0055	0.229281	11.0055		
Total VOC Fugitive Emissions			19.6264		11.7852	3.5818	2.1508

TOTAL for Permit **6.7107** **4.2890**